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Organization of the
United Nations



Pathways to forest data transparency:

Best practices from
national forest monitoring
to support climate action



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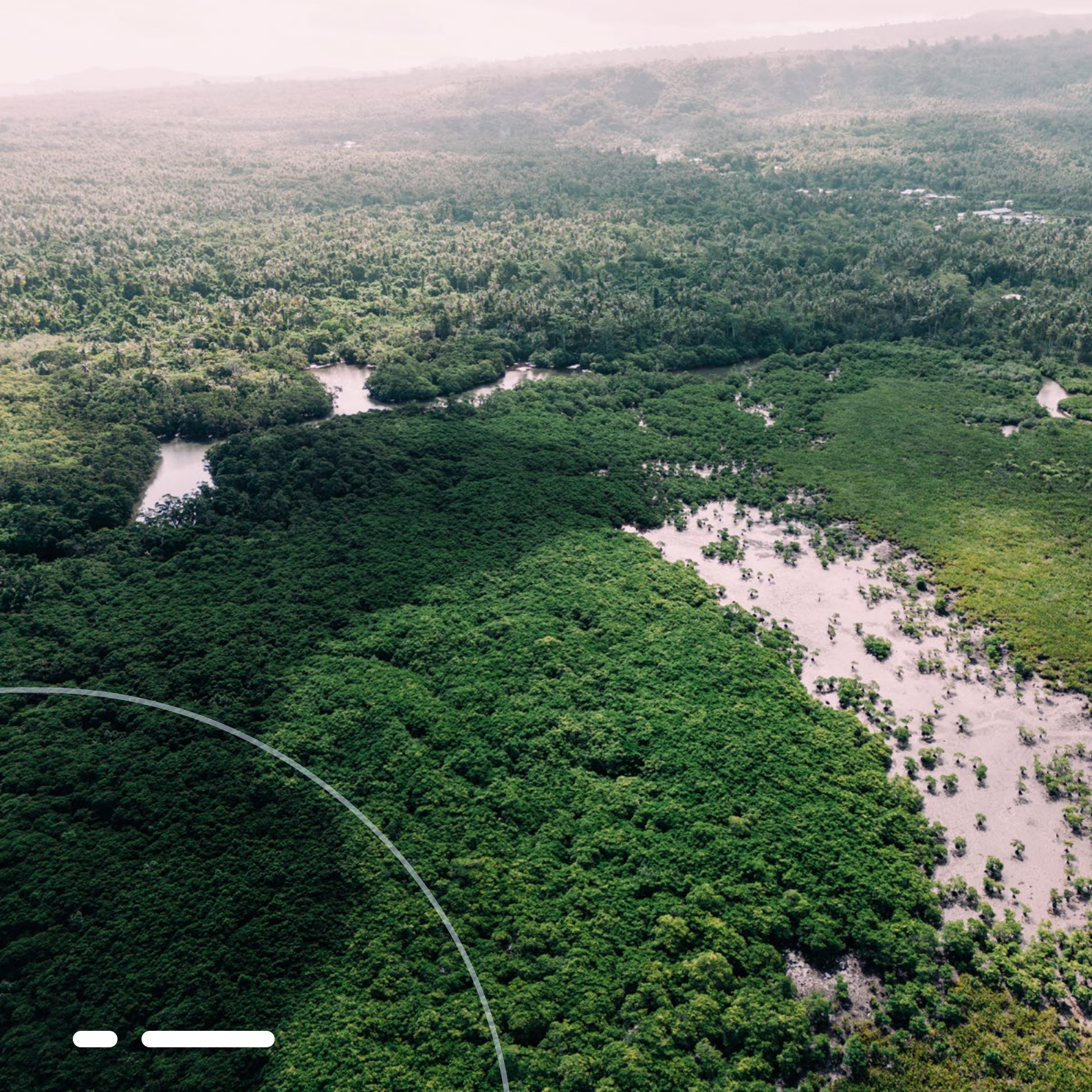
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ABBREVIATIONS

BFIS	Bangladesh Forest Information System
CAFI	Central African Forest Initiative
CONAFOR	National Forestry Commission (Mexico; Comisión Nacional Forestal)
DoF	Department of Forestry
ENCCRV	National Strategy on Climate Change and Vegetation Resources (Chile; La Estrategia Nacional de Cambio Climático y Recursos Vegetacionales)
ETF	Enhanced Transparency Framework
FAO	Food and Agriculture Organization of the United Nations
FD	Forest Department
FRA	Forest Resources Assessment
GHG	greenhouse gases
GTSMRV	Technical Management of the Monitoring, Reporting, and Verification System (Mexico; Gerencia Técnica del Sistema de Monitoreo Reporte y Verificación)
INFyS	National Forest and Soils Inventory (Mexico; Inventario Nacional Forestal y de Suelos)
LAC	Latin America and the Caribbean
LEAF	Lowering Emissions by Accelerating Forest finance
MRV	Measurement, reporting, and verification
NDC	nationally determined contribution
NFA	National Forestry Authority
NFMS	national forest monitoring system
NGO	non-governmental organization
REDD+	Reduction of emissions from deforestation and forest degradation, and the enhancement of forest carbon stocks
SDG	Sustainable Development Goal
SEPAL	System for Earth Observation Data Access, Processing and Analysis for Land Monitoring
SMM	Monitoring and Measurement System (Chile; Sistema de Medición y Monitoreo)
UNFCCC	United Nations Framework Convention on Climate Change



1. Introduction



Importance of transparency in forest data management

At the twenty-first United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties held in Paris, countries adopted the Paris Agreement on 12 December 2015, marking a historic commitment to combat climate change (UNFCCC, 2015). The Paris Agreement aims to limit the increase in global mean temperature to well below 2 °C above pre-industrial levels, with efforts to limit it to 1.5 °C. Forest-based natural climate solutions are recognized internationally as critical to achieving these goals because of their significant potential for mitigation of and adaptation to climate change while providing numerous ecosystem co-benefits (Roe *et al.*, 2017).

In 2022, the land sink – mainly forests absorbed 33 percent of human-induced CO₂ emissions, underscoring its vital role in carbon sequestration (Friedlingstein *et al.*, 2023). However, that same year, land use change (mainly deforestation) was responsible for 11 percent of CO₂ emissions (Friedlingstein *et al.*, 2023). Reducing deforestation and promoting forest restoration are considered cost-effective mitigation strategies that align with sustainable development and adaptation efforts (IPCC, 2022).

Many countries have acknowledged the importance of the forest sector in their nationally determined contributions (NDCs) under the Paris Agreement, with some setting specific forest-related targets (IUCN & Climate Focus, 2018). To meet these targets, robust national forest monitoring systems (NFMSs) are essential. These systems must accurately and transparently estimate greenhouse gas (GHG) emissions and removals, supporting the Enhanced Transparency Framework (ETF) established under Article 13 of the Paris Agreement. This framework requires all parties to regularly report on their GHG emissions and progress towards their NDCs (Dagnet *et al.*, 2019).

Despite the critical need for high-quality forest data, progress in forest monitoring capacity varies across countries and regions. In light of the growing emphasis on transparency and the need for reliable data, this publication examines case studies of NFMSs that are transparent, reliable, and capable of supporting both national and international reporting requirements. These “good practices” can help in understanding and implementing multipurpose NFMSs tailored to national needs and aligned with international standards.

Role of FAO in promoting transparent forest data worldwide



The Food and Agriculture Organization of the United Nations (FAO) plays a pivotal role in advancing transparency in forest data on a global scale. As a leading international body dedicated to the sustainable management of the world's forests, FAO has long recognized the importance of accessible and reliable data in achieving its mission of forest conservation and sustainable use. FAO's initiatives are designed to enhance the capacity of countries to collect, analyse, and disseminate forest-related data, thereby fostering an environment of transparency and accountability in forest management.

FAO promotes transparency through the development and dissemination of standardized methodologies and tools that ensure consistency and comparability of forest data across countries. One of the key initiatives is the [Global Forest Resources Assessment \(FRA\)](#), a comprehensive report that provides consistent, comparable, and up-to-date data on the state of the world's forests. The FRA is an essential resource for policymakers, researchers, and stakeholders, offering insights into forest trends and helping to inform decisions on forest management at national and international levels.

In addition to its flagship assessments, FAO supports countries in building robust NFMSs that are critical for meeting the reporting requirements under international agreements such as the Paris Agreement. These systems are designed to accurately and transparently estimate GHG emissions and removals, thereby supporting countries in tracking progress towards their NDCs. FAO also offers technical assistance, training, and capacity development programmes to help countries improve their forest data collection and reporting capabilities.

Furthermore, FAO plays a key role in the implementation of the ETF under the Paris Agreement. The organization helps countries to establish and maintain the necessary institutional frameworks and technical capacities required for the regular reporting of forest-related data. By doing so, FAO ensures that countries can meet the transparency, accuracy, completeness, consistency, and comparability guiding principles of forest monitoring and ETF. FAO's commitment to promoting transparent forest data is also reflected in its collaborative efforts with other international organizations, governments, and non-governmental organizations (NGOs). By facilitating the exchange of knowledge and best practices, FAO helps to build a global network of forest data that is open, reliable, and accessible to all stakeholders. This collaborative approach not only enhances the quality and availability of forest data but also strengthens international cooperation in addressing global forestry challenges.

Purpose of this publication

This publication aims to provide comprehensive and actionable guidelines on best practices for forest data transparency. By offering detailed insights into the principles and methodologies that support open and accessible forest data, it seeks to empower stakeholders across various sectors to enhance the quality, availability, and usability of forest-related information. Whether you are a government official, researcher, NGO worker, or member of a local community, this publication is designed to help implement effective data transparency practices and assist in improving data collection, sharing, and use, ultimately contributing to more informed and sustainable forest management worldwide.

The inclusion of country-specific best practices in the booklets is of paramount significance for several reasons. Forests vary greatly across different regions in terms of ecosystems, socioeconomic conditions, and governance structures, making it essential to tailor transparency practices to the unique contexts of individual countries.



- ▶ **Contextual relevance:** Country-specific best practices ensure that the guidelines provided are relevant and applicable within the local context. This increases the likelihood of successful implementation, as the practices are designed to align with existing national frameworks, policies, and capacities.
- ▶ **Building on local knowledge:** By highlighting practices that have been successfully implemented in specific countries, the booklets leverage local knowledge and expertise. This not only validates the effectiveness of the practices but also empowers other countries to adapt and innovate based on proven approaches.
- ▶ **Encouraging peer learning and cooperation:** Sharing country-specific best practices fosters a culture of peer learning and cooperation. Countries can learn from each other's experiences, avoiding common pitfalls and adopting strategies that have been shown to work in similar contexts. This exchange of knowledge enhances global efforts to improve forest data transparency.
- ▶ **Addressing unique challenges:** Every country faces its own set of challenges in forest data management, whether related to technical capacity, data availability, or institutional coordination. Country-specific best practices provide targeted solutions to these challenges, helping countries to overcome obstacles and achieve greater transparency in their forest data.

2. Best practices: Africa

Democratic Republic of the Congo



Overview of forest data management context in the Democratic Republic of the Congo

The Democratic Republic of the Congo is a Central African country where the reduction of emissions from deforestation and forest degradation, and the enhancement of forest carbon stocks (REDD+) is a major national strategic priority. The country's vast forest resources are critical for biodiversity, carbon storage, and supporting local communities. However, the Democratic Republic of the Congo has historically faced challenges in technical capacity, limiting its ability to monitor forest cover, detect changes, and make informed policy decisions related to sustainable forest management and emissions reductions.

Recognizing the importance of robust forest monitoring, the Democratic Republic of the Congo has established an NFMS, also known as the National Monitoring System for Measurement, Reporting and Verification, to promote sustainable forest management. This system is designed to improve the proactive monitoring of deforestation and forest degradation and to support the country's efforts to meet both national and international reporting requirements under frameworks such as the UNFCCC. Under the 2020 Forest Code (Law No. 33-2020 of 08 July 2020), REDD+ is a forest management policy recognized by the country and is a key element in its NDC.



Detailed guide on best practices for forest data transparency in the Democratic Republic of the Congo

- ▶ **Implementation of a robust NFMS:** The NFMS in the Democratic Republic of the Congo is a multipurpose approach aimed at producing high-quality, reliable data to monitor changes in land use, land cover, and forest cover. It supports the analysis and tracking of progress made by REDD+ activities at the national scale, providing essential information for the Democratic Republic of the Congo to meet its national and international reporting obligations under the UNFCCC. The system also plays a crucial role in helping the government make ecologically sustainable decisions on land use and natural resources management.
- ▶ **Strengthening national capacities:** The Democratic Republic of the Congo has focused on building the technical capacity of its national institutions, particularly the National Center for Inventory and Management of Forest and Wildlife Resources of the Ministry of Forest Economy. This NFMS initiative aims to include extensive training programmes to improve the skills of officials in areas such as satellite monitoring, forest inventory planning, and data analysis. These efforts ensure that the NFMS is maintained and updated with accurate and reliable data.
- ▶ **Participatory and inclusive approach:** The design and implementation of the NFMS have been supported by a wide range of stakeholders, including national universities, international organizations, NGOs, and technical partners. A key success factor is the participatory discussion process facilitated by the technical and steering committees held during the NFMS operationalization. This collaboration strengthened coordination between relevant stakeholders, ensuring that the NFMS meets the needs of all parties involved.
- ▶ **Integration with national and international reporting:** The NFMS in the Democratic Republic of the Congo not only is a tool for international reporting to the UNFCCC but also provides valuable information for stakeholders of the agriculture, forestry and other land-use sectors, including those in mining. The system's ability to use high-resolution satellite images and produce detailed forest inventories has significantly improved the accuracy of GHG emissions estimates, enhancing the country's capacity to meet its commitments under the Paris Agreement.
- ▶ **Sustainability of NFMS:** The Democratic Republic of the Congo is working to enhance the sustainability and ongoing maintenance of its NFMS, particularly by addressing funding availability and strengthening system coordination across sectors. Currently supported by donor funding for data processing and analysis, the country is exploring more sustainable financial mechanisms to ensure long-term success.



Overview of forest data management context in Ghana

In Ghana, forest degradation and deforestation are primarily driven by unsustainable logging, fuelwood harvesting, agricultural expansion, and shifting cultivation. These activities have significantly diminished the country's forest cover, necessitating robust measures to monitor and manage forest resources sustainably. Since 2008, Ghana has engaged in REDD+ activities, culminating in the development of a national REDD+ strategy in 2016. This strategy serves as a roadmap for implementing REDD+ programmes across the country's landscapes, including the pioneering Ghana Cocoa Forest REDD+ Programme, the world's first commodity-based emission-reduction initiative.

Currently, Ghana is transitioning to performance-based REDD+. In 2019, the country signed a five-year Emission Reduction Payment Agreement with the World Bank's Forest Carbon Partnership Facility, which supports the design and implementation of Ghana's NFMS. This NFMS serves as a critical source of data for land-use and forest management, providing essential information on REDD+ activities. It also plays a key role in managing and planning other forestry-related sectors, such as cocoa production. The NFMS aims to enhance the efficiency and effectiveness of forest and land-use monitoring by integrating components currently managed by different institutions into a cohesive system. In 2021, Ghana submitted a proposal to the Lowering Emissions by Accelerating Forest finance (LEAF) initiative. With support from FAO, Ghana assessed its emission reductions, becoming the first African country to submit a monitoring report to the REDD+ Environmental Excellence Standard and, together with Costa Rica, one of the first two countries to sign an Emission Reduction Payment Agreement with Emergent. This agreement positions Ghana to contribute to the LEAF coalition, marking a significant step forward in global climate action.



Detailed guide on best practices for forest data transparency in Ghana

▶ Establishment of a multipurpose NFMS: Ghana's NFMS is a multipurpose system designed to improve land-use monitoring capacities and strengthen the accuracy and accessibility of forest-related data for meeting national and international climate targets. The NFMS, when fully operational, will centralize data from various sources in a web portal, which will include three main components: a GHG inventory, environmental and social safeguards, and a registry subsystem. This system is designed to support transparent communication of REDD+ activities and financial flows, while also providing critical information for the management of related sectors like cocoa.

Support for stakeholder engagement: The NFMS is designed to provide

▶ relevant and transparent information to key stakeholders, including private sector entities, NGOs, and government agencies. This engagement ensures that all parties involved in forest management have access to the most current and accurate information, facilitating better decision-making and fostering accountability.

Integration of existing information



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BOX 1 Regional collaborations - Africa

Sharing best practices for sustainable forestry in West Africa

Ghana's pioneering efforts in forest data transparency and sustainable forest management have positioned the country as a leader in West Africa, particularly through the development and implementation of its national forest inventory. The Forestry Research Institute of Ghana, a key research facility in the country, is instrumental in advancing these efforts. With the support of FAO and the Economic Community of West African States, Ghana's experiences and lessons learned are now being shared with other countries across West Africa through the project "[Global Transformation of Forest for People and Climate: A focus on West Africa](#)".

Under this project, an [assessment of forest data availability and related technical capacity needs in West Africa](#) was published and marked a step forward in forest data reporting. This assessment fills in critical information gaps on forest condition, land-use and land-cover dynamics, and capacity development needs.

The project has also benefited from knowledge shared by other regions in Africa. For example, through the Central African Forest Initiative (CAFI), FAO conducted an [assessment on the drivers of deforestation and forest degradation in Central Africa](#), developing and harmonizing a comprehensive methodology across all CAFI countries. This approach not only enhanced forest data transparency and consistency in Central Africa but was subsequently adopted in West Africa under a Swedish International Development Cooperation Agency-funded project.

More: <https://openknowledge.fao.org/items/c3edebdf-3026-4c5f-9f38-bc9a2f1d789a>

- ▶ sources: A technical and operational review of existing NFMS components was conducted to improve the design and functionality of Ghana's system. The goal was to harmonize data across different institutions, ensuring consistency and enhancing the system's usefulness for both national and international reporting.

- ▶ Capacity building and institutional support: The Forestry Commission, under the Ministry of Lands and Natural Resources, is responsible for the development and management of the NFMS. With support from FAO and the Forest Carbon Partnership Facility, the commission has developed standard operating procedures and user manuals to guide the collection of activity data and emission factors, ensuring transparency and up-to-date methodologies. Additionally, Ghana has focused on building sustainable institutional arrangements and technical capacity, aiming to reduce reliance on donor funding and international experts. However, challenges remain, particularly in securing sustainable and predictable funding for the National REDD+ Secretariat and reducing donor dependence for data processing and analysis.

- ▶ Gender participation and South-South cooperation: Ghana has implemented a gender-responsive approach in its emission-reduction programmes, integrating a gender analysis and action plan within the Cocoa Forest Program. The country also participates in South-South cooperation, sharing knowledge and experiences with other nations to build REDD+ capacity and advance the Sustainable Development Goals (SDGs).



Overview of forest data management context in Uganda

Uganda is home to diverse forest ecosystems, including tropical rainforests, montane forests, and savannah woodlands, with woodlands predominating in area. FAO's FRA indicates that forests occupy 12 percent of Uganda's total land area, but they are declining at an annual rate of 1.4 percent due to deforestation. Effective forest data management is crucial for addressing the challenges these ecosystems face.

Uganda's NFMS combines remote sensing with a ground-based forest carbon inventory. The system is both robust and transparent, with robustness ensured through a carefully designed statistical sampling approach that provides representative estimates for the entire national territory, covering both activity data and emission factors. The activity data is derived from stratified area estimation, where forest area change maps inform the stratification of sample data. Emission factors rely on a national forest inventory, which produces national values based on a statistically representative sample distribution, avoiding biases associated with localized inventories. So far, four national inventories have been conducted; of particular note, the Wildlife Conservation Society has conducted an inventory of all forests in the Albertine region of Uganda. Quite a significant amount of data is still held by the private sector, and its inclusion into Uganda's inventory data is paramount.

Detailed guide on best practices for forest data transparency in Uganda

▶ **Transparency and quality:** Uganda was the first country to openly share the metadata, microdata, and documentation of its national forest inventory (National Biomass Survey), through FAO's [Food and Agriculture Microdata Catalogue](#). This transparency is ensured by providing details on the data collection process, including sampling design, labelling protocols, and confidence intervals for emission factors and activity data. The data is now accessible to all for monitoring and evaluation, tailoring programmes and interventions, and monitoring important trends. Additionally, by promoting access to these datasets, Uganda maximizes their value for evidence-based decision-making, enabling open research and analysis.

Integration of and consistency with existing information sources: The System for Earth Observation Data Access, Processing and Analysis for Land Monitoring ([SEPAL](#)), a free and open-source online platform for processing geospatial data, has been integrated into Uganda's NFMS. This integration enables Uganda's National Forestry Authority (NFA) to efficiently process, store, and analyse satellite images, producing accurate, transparent, and consistent forest-change statistics. Additionally, the collaboration with the SEPAL team aims to enhance the usability and relevance of the tools for Uganda through co-development efforts.

Partnerships and collaboration at the national level: The Ministry of Water and Environment through NFA



- ▶ partnered with the National Agricultural Research Institute to undertake national soil organic carbon stocks (collected soil samples, with special attention to forest and changed forest areas), quantified soil carbon stocks with indicative forest litter information, and developed datasets and tools for assessing volumetric soil organic carbon stocks.

Collaboration at the international level: The integration of SEPAL into Uganda's NFMS was made possible by a longstanding partnership, established in 2013, between

- ▶ Uganda's GIS and Remote Sensing team and the FAO Forest Monitoring and Data Platforms team. The Ministry of Water and Environment, through the NFA and FAO teams, worked closely to enhance the NFMS using SEPAL tools, with the NFA team contributing to SEPAL's development. This collaboration was supported by FAO's technical assistance, funded by the Government of Japan, Norway's International Climate and Forest Initiative, the UN-REDD Programme and the World Bank. Additionally, the Ministry of Water and Environment through NFA partnered with the Jane Goodall Institute to pilot a gender-responsive, community-led forest monitoring initiative and to integrate data into the national measurement, reporting, and verification (MRV) system across five parishes in Hoima District.

Institutionalization of national forest monitoring:

The forestry sector in Uganda is under the Directorate of Environment Affairs within the Ministry of Water and Environment. Management is delegated to

- ▶ three main institutions: the Forestry Sector Support Department, the NFA, and the District Forestry Services. The Uganda Wildlife Authority under the Ministry of Tourism, Wildlife and Antiquities manages the forests under its jurisdiction for tourism and conservation purposes. This authority seeks technical support from the Ministry of Water and Environment's Forestry Department and the NFA if necessary. The Climate Change Department of the Ministry of Water and Environment provides oversight on national GHG inventories within the forestry and other sectors. The technical functions of the NFMS are currently managed almost entirely by the NFA, a semiautonomous institution established in 2003 under Section 52 of the National Forestry and Tree Planting Act, officially launched on April 26, 2004. In response to the need to strengthen collaboration within the NFMS, Uganda is developing a data-sharing protocol between the NFA and key institutions, including the Forestry Sector Support Department, the Climate Change Department, the National Environment Management Authority, and the Uganda Bureau of Statistics. This protocol will enhance the flow of information and clarify roles and responsibilities, fostering effective inter-institutional cooperation.

3. Best practices: Asia and the Pacific

Lao People's Democratic Republic



Overview of forest data management context in the Lao People's Democratic Republic

A significant portion of the land of the Lao People's Democratic Republic is covered by forests, which are critical for biodiversity, carbon sequestration, and the livelihoods of local communities. The country has been involved in REDD+, a key component of its national strategy to address climate change and promote sustainable forest management. As part of these efforts, the Department of Forestry (DoF) under the Ministry of Agriculture and Forestry conducted comprehensive forest assessments in 2019 and 2022.

In 2019, the DoF measured forest area with a two-step methodology using remote-sensing technology. This included producing a forest-change map by comparing current forest cover with the national 2015 forest-cover map, followed by a stratified sample-based analysis to correct any possible biases in the map. These assessments, supported by the Japan International Cooperation Agency, have been crucial in estimating the national forest area and informing the country's REDD+ strategy. Data from the 2015 assessment was used in Lao People's Democratic Republic's Forest Reference Level for REDD+ in 2018, and the 2019 data similarly was used for the first national REDD+ results report, both submitted to the UNFCCC in 2020. A similar process was used to generate 2022 data. Both 2019 and 2020 data contributed to the FAO's FRA 2020 and 2025 Lao country report, respectively.



Detailed guide on best practices for forest data transparency in the Lao People's Democratic Republic

- ▶ **Two-step methodology for forest-area measurement:** The forest area in the Lao People's Democratic Republic was measured using a two-step methodology combining remote-sensing technology and stratified sampling. This approach allows for a detailed and accurate assessment of forest cover and changes over time. The first step involves creating a forest-change map by comparing current forest cover with the most recent historical national forest cover map. The second step involves using a stratified sample-based analysis to correct any biases in the map, ensuring the data's reliability and accuracy.
- ▶ **Integration with international reporting requirements:** The forest-area data collected in the 2015, 2019 and 2022 assessments was critical for international reporting. The 2015 data, for instance, was used in the Lao People's Democratic Republic's submission of its Forest Reference Level for REDD+ to the UNFCCC in 2018 and its [REDD+ technical annex](#) submission with the biennial update report in 2020, demonstrating the country's commitment to transparency in reporting. The Forest Reference Level, submitted to the UNFCCC, provides a benchmark for measuring the country's progress in REDD+, further underscoring the importance of accurate and transparent forest data. Furthermore, this data was included in the FAO's FRA 2020 Lao People's Democratic Republic country report, ensuring that the country's forest data is consistent with global standards and can be compared with data from other countries.

Working on challenges in forest-area measurement: One of the challenges identified in the forest-area measurement process in the Lao People's Democratic Republic is the discrepancy between different definitions of "forest cover" used by the DoF and those employed in international assessments like the FAO FRA. The DoF's definition of "current forest" applies a minimum canopy-cover threshold of 20 percent, whereas the FAO FRA uses a threshold of 10 percent. This difference highlights the need for clear definitions and consistent methodologies for estimating forest areas, especially for reporting at both national and international levels.

- ▶ **Capacity building and international cooperation:** The forest assessments in the Lao People's Democratic Republic have benefited from strong international cooperation, particularly with the Japan International Cooperation Agency, which has provided technical and financial support. This collaboration not only has improved the accuracy of forest data but also has built national capacities in forest monitoring. The data and methodologies developed through these assessments are now contributing to broader efforts to enhance transparency and accountability in forest management across the Asia-Pacific region.

Papua New Guinea



Overview of forest data management context in Papua New Guinea

Papua New Guinea, located in the South Pacific region, is home to the third-largest tropical rainforest in the world, following the Amazon Basin and Congo Basin. The country's forests, which cover approximately 78 percent of its land area, are vital for biodiversity, climate regulation and the livelihoods of its people, with about 97 percent of the land under customary tenure. However, forest management faces challenges because of pressures from subsistence agriculture, agricultural plantations (particularly oil palm), and commercial logging. These activities have led to increasing rates of deforestation and forest degradation, posing a threat to the sustainability of Papua New Guinea's forest resources.

In response to these challenges, Papua New Guinea has made substantial efforts to improve its forest monitoring systems as part of its commitment to REDD+. The country was one of the initial proponents of REDD+ at the UNFCCC in 2005 and has since been developing its NFMS to support sustainable forest management and climate action.



Detailed guide on best practices for forest data transparency in Papua New Guinea

- ▶ **Comprehensive and transparent forest monitoring:** Papua New Guinea's NFMS is designed to provide free, transparent and timely access to all relevant data and information on forest and land use. This system ensures that data is delivered consistently, accurately and in a verifiable manner, in line with the NFMS Methodological Guidance provided by the UNFCCC. The NFMS integrates both domestic and global information sources, such as the land-use map produced using TerraPNG, point-sampling land-use data generated with Collect Earth, and data from Global Forest Watch, to provide the highest standard of accuracy in monitoring land-use changes.

- ▶ **Accurate estimation of GHG emissions:** The NFMS is crucial for accurately estimating GHG emissions from the land-use change and forestry sector. With the completion of the national forest inventory, which is currently under implementation, the NFMS will meet the Tier 3 emission-factors requirements as prescribed by the Intergovernmental Panel on Climate Change for REDD+ MRV. This level of precision is essential for Papua New Guinea to monitor its national policies and strategies effectively, meet its forest-related targets and fulfil its pledges under the Paris Agreement, including its NDC.
- ▶ **Enhanced land-use planning and decision-making:** The NFMS provides precise and comprehensive annual land-use change information, which is vital for enhancing land-use planning and supporting informed decision-making. By offering detailed spatial information on forests, agriculture, mining and other key sectors, the system supports the government's ability to make ecologically sustainable decisions that align with both national development goals and international climate commitments.
- ▶ **Integration and capacity building:** The NFMS builds on existing systems for land-use and forest-resource mapping in Papua New Guinea, ensuring consistency with previously established methodologies. The Climate Change and Development Authority and the Papua New Guinea Forest Authority are the core implementing partners responsible for developing and maintaining the NFMS. The system has

significantly benefited from technical and financial support provided by international partners, including FAO under the UN-REDD Programme and the European Union. This support has enhanced the country's capacity in forest monitoring, allowing for more accurate and timely data collection and reporting.

- ▶ **Forest inventory and monitoring:** While forest monitoring has been progressing, there is still a lack of comprehensive forest inventory data – particularly for estimating forest carbon in the five carbon pools across different forest types and levels of disturbance – an issue that the country is actively working to address. The country's extensive forests, rugged terrain, and limited infrastructure, and the lengthy process required to obtain landowner consent for forest access make the national forest inventory) expensive and time-consuming.

- ▶ **Regional knowledge sharing and replicability:** Papua New Guinea's experience and expertise in forest monitoring are being shared with other countries in the region, promoting knowledge exchange and capacity building. The detailed documentation of field protocols and the production of manuals during the national forest inventory activities ensure that the approaches used in Papua New Guinea are transparent and replicable. The Papua New Guinea Forest Authority plans to continue sharing its knowledge with other countries, contributing to broader regional efforts in sustainable forest management and climate action.



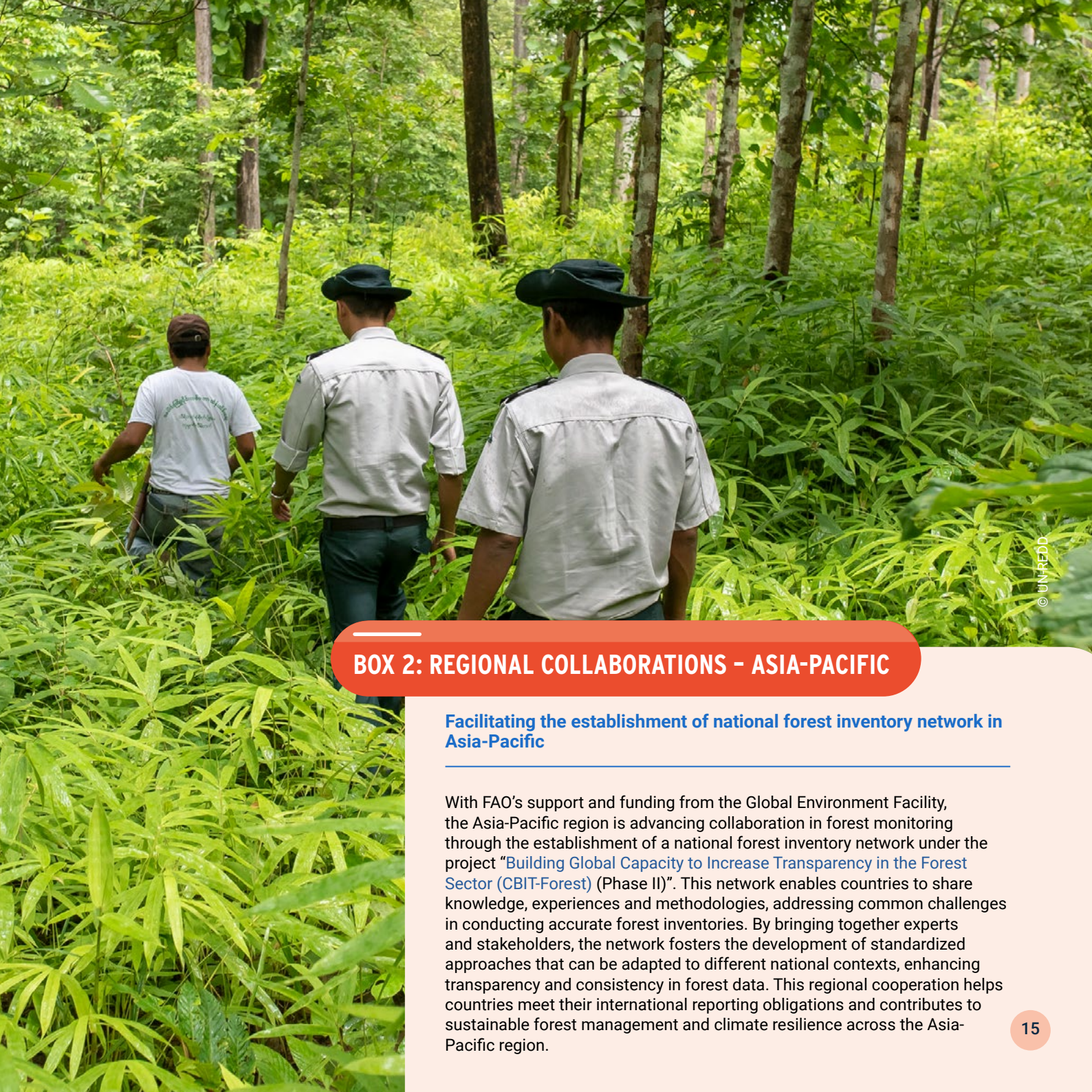
Overview of forest data management context in Bangladesh

Bangladesh is highly vulnerable to the impacts of climate change, making access to robust and comprehensive forest data critical for effective decision-making in climate change mitigation and adaptation. Historically, forest data in Bangladesh was scattered across various offices within the Forest Department (FD) under the Ministry of Environment, Forest, and Climate Change, leading to issues with data completeness, consistency and accessibility. To address these challenges, the Bangladesh Forest Information System (BFIS) was launched in December 2018, becoming the country's first integrated platform to assess, monitor, document and manage forest-related activities at a national scale.



Detailed guide on best practices for forest data transparency in Bangladesh

- ▶ **Integrated NFMS:** The BFIS serves as a centralized, web-based platform providing access to the most current, consistent, and reliable information on forest resources in Bangladesh. Developed with technical support from FAO and financial backing from the United States Agency for International Development and the UN-REDD Bangladesh National Programme, the system facilitates data-sharing, accessibility and management of forest-related data across various stakeholders.
- ▶ **Supporting multi-objective forest management:** The BFIS is designed to support the planning, implementation and monitoring of multi-objective forest management and conservation activities. This includes natural resources management, biodiversity monitoring, GHG accounting and climate change mitigation, ensuring that these activities are aligned with national and international goals, such as the SDGs and the Bangladesh NDC.
- ▶ **Strengthening institutional capacity:** The Resources Information Management System unit of the FD is responsible for maintaining and updating the BFIS. The system's integration with the FD website and its compatibility with international standards for land-cover classification and geospatial data management have significantly enhanced the ability of officials to manage forest-related databases. Training programmes under the UN-REDD Bangladesh National Programme have further strengthened technical capacities in areas such as GIS, forest statistics and data analysis.
- ▶ **Sustainability of NFMS:** Despite its successes, the sustainability of BFIS could be strengthened, particularly by securing long-term funding and ensuring the availability of skilled IT professionals for system management. To address these issues, the FD has developed a user manual for system operation and maintenance, along with a data-sharing policy aligned with the Right to Information Act, ensuring that data is accessible under defined terms and conditions.
- ▶ **Replicability and upscaling:** The BFIS has been designed with scalability in mind, with its modules organized into categories that allow for easy expansion and adaptation. The comprehensive documentation and user-friendly interfaces make it a model that can be replicated in other contexts, supporting broader efforts to enhance forest data transparency and management across the region.



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BOX 2: REGIONAL COLLABORATIONS - ASIA-PACIFIC

Facilitating the establishment of national forest inventory network in Asia-Pacific

With FAO's support and funding from the Global Environment Facility, the Asia-Pacific region is advancing collaboration in forest monitoring through the establishment of a national forest inventory network under the project "[Building Global Capacity to Increase Transparency in the Forest Sector \(CBIT-Forest\)](#) (Phase II)". This network enables countries to share knowledge, experiences and methodologies, addressing common challenges in conducting accurate forest inventories. By bringing together experts and stakeholders, the network fosters the development of standardized approaches that can be adapted to different national contexts, enhancing transparency and consistency in forest data. This regional cooperation helps countries meet their international reporting obligations and contributes to sustainable forest management and climate resilience across the Asia-Pacific region.

4. Best practices: Latin America and the Caribbean

Costa Rica



Overview of Forest Data Management Context in Costa Rica

Costa Rica, a Central American nation renowned for its rich biodiversity and extensive tropical forests, has been a global leader in conservation and recovery. Recognizing the interdependence of forest, biodiversity and agricultural resources, Costa Rica has made significant strides in integrating the monitoring of these resources to support informed decision-making. Since 2015, the Government of Costa Rica has been developing the [National Land Use, Land Cover, and Ecosystems Monitoring System](#) (Sistema Nacional de Monitoreo de la Cobertura y Uso de la Tierra y Ecosistemas; SIMOCUTE). This system serves as the official platform for integrating and managing ecosystem data and information on a national scale.

SIMOCUTE addresses the need for a consistent, integrated and comprehensive monitoring system that consolidates data from multiple sectors, including forest and agricultural resources, which are assessed independently. The system is supported by the Ministry of Environment and Energy and the Ministry of Agriculture and Livestock and was developed through a participatory, interinstitutional process led by the National Center for Geoenvironmental Information. SIMOCUTE involves collaboration of 40 institutions in government, academia and the private sector, making it a cornerstone of Costa Rica's efforts to enhance environmental governance.



Detailed guide on best practices for forest data transparency in Costa Rica

- ▶ **Integrated monitoring system:** SIMOCUTE is an all-lands, multipurpose system that allows for the monitoring of natural ecosystems, agricultural resources and biodiversity. It provides high-quality, consistent data on land use, land cover and ecosystems, facilitating better access to data and improving transparency on emission reduction results. The system also enhances the management and distribution of knowledge and information associated with these resources, supporting informed decision-making for sustainable land management.
- ▶ **Strengthening national capacities:** A key objective of SIMOCUTE is to strengthen national capacities for data collection, analysis and management. This is achieved through comprehensive training programmes, which are focused on developing protocols and technical documents, and adapting technological applications for monitoring land use and land cover. By building national expertise, Costa Rica ensures that SIMOCUTE remains a robust and cost-effective tool for long-term environmental monitoring.
- ▶ **Harmonization of methodologies:** SIMOCUTE emphasizes the harmonization of methodologies, protocols, classification systems, indicators and metrics related to land use, land cover and ecosystems. Six technical working groups have been established to develop standardized methods and protocols that align with national and international standards. This harmonization is crucial for maintaining the quality and integrity of environmental data and for ensuring that the data is consistent across different sectors and institutions.
- ▶ **Institutionalization and legal framework:** SIMOCUTE is implemented through a well-defined institutional structure led by the National Center for Geoenvironmental Information, within the context of the National Environmental Information System. SIMOCUTE operation is supported by an interministerial decree endorsed in 2021, which regulates its functioning and formalizes the roles and responsibilities of the participating institutions. This legal and policy basis ensures the long-term sustainability and effectiveness of SIMOCUTE.
- ▶ **Sustainability of NFMS:** Despite its successes, SIMOCUTE faces challenges related to financial sustainability, the ongoing development of training programmes, and the strengthening of institutional arrangements. Addressing these challenges is essential for maintaining the system's effectiveness and for supporting Costa Rica's broader environmental and climate goals.
- ▶ **Regional collaboration and replicability:** Costa Rica's experience with SIMOCUTE has been shared with other countries in the region, fostering South-South cooperation and the exchange of best practices. For instance, in May 2018, Ecuadorian technicians visited Costa Rica to exchange experiences on forest monitoring systems and forest fires, facilitated by FAO. Such exchanges help identify synergies and possible areas for collaboration, making SIMOCUTE a model for other nations seeking to enhance their environmental monitoring systems.



Overview of forest data management context in Chile

Chile, a country with diverse ecosystems and significant forest resources, has been proactive in addressing climate change through REDD+. Since 2017, Chile has implemented its National Strategy on Climate Change and Vegetation Resources (La Estrategia Nacional de Cambio Climático y Recursos Vegetacionales; ENCCRV), developed by the Ministry of Agriculture through the National Forestry Corporation. The ENCCRV is a comprehensive strategy that aligns with the demands of the UNFCCC and addresses the land-use, land-use change, and forestry sector for REDD+ activities.

To effectively monitor and measure the impacts of ENCCRV, the National Forestry Corporation launched the Monitoring and Measurement System (Sistema de Medición y Monitoreo; SMM) in March 2018. The SMM encompasses Chile's NFMS and integrates various institutional arrangements, data sources, and reporting mechanisms to support climate change mitigation and adaptation efforts. The SMM is designed to function with a planning horizon extending to 2025, ensuring long-term sustainability and impact.



Detailed guide on best practices for forest data transparency in Chile

▶ **Comprehensive monitoring system:** The SMM in Chile is built on the principles of transparency, precision and consistency. It integrates various systems, institutional arrangements and sources of information, focusing specifically on the NFMS within a broader environmental monitoring framework. The SMM provides detailed data on the outcomes of the ENCCRV, covering key areas such as forest-related GHG emissions and removals, desertification, land degradation and non-carbon benefits.

Enhancing international reporting and compliance:

▶ The SMM is designed to meet the monitoring and reporting requirements of international agreements, including the Paris Agreement and the United Nations Convention to Combat Desertification. It strengthens Chile's National Greenhouse Gases Inventory and links the monitoring of ENCCRV implementation with global biodiversity goals and the SDGs. This comprehensive approach ensures that Chile's forest data is accurate, consistent and aligned with international standards, facilitating access to results-based payments for REDD+.

Technological innovation and data accessibility:

▶ Chile has advanced in using state-of-the-art technologies to improve forest monitoring. The SMM includes spatial and alphanumeric databases and a semi-automatic integration tool. These tools allow for the partially automated development of reports, reconstruction of information, and the performance of specific consultations, ensuring that data and information are disseminated clearly and transparently.

Institutionalization and legal framework: In 2017, the Ministry of Agriculture institutionalized an

▶ interministerial structure through Exempt Decree No. 360, which created the Interministerial Technical Committee on Climate Change. This structure facilitates the organization of actions related to climate change mitigation and adaptation, ensuring that the NFMS is supported by a solid legal and policy foundation.

Participatory and collaborative approach:

▶ The development and implementation of Chile's NFMS and SMM have been guided by a participatory process involving stakeholders at national and regional levels. Workshops and training activities are regularly conducted, bringing together experts from public institutions and academia to ensure that the design and implementation of NFMS reflect the needs and priorities of all stakeholders. This collaborative approach enhances the legitimacy and effectiveness of the monitoring system.

Challenges and opportunities:

▶ Building on its progress, Chile continues to explore ways to reduce uncertainties in GHG emissions and removals estimates and in improving data quality for international reporting. Strengthening the technical capacities of the National Forestry Corporation and other institutions is crucial for overcoming these challenges. However, the SMM's design allows for ongoing revisions and improvements, ensuring that it remains responsive to the evolving needs of forest monitoring and climate action in Chile.

Mexico



Overview of forest data management context in Mexico

Since 2011, Mexico has strengthened its national capacity for monitoring forest cover through various projects and initiatives, ensuring the collection of robust, high-quality data on the status and dynamics of its forest resources. Mexico's NFMS is a national system covering the national territory and consists of three components: (1) the National Forest and Soils Inventory (Inventario Nacional Forestal y de Suelos; INFyS), (2) the satellite-based forest monitoring system, and (3) the NFMS for measurement, reporting and verification. The design and implementation of the NFMS has been essential in facilitating the production, accessibility and dissemination of information related to vegetation and soil cover. The NFMS assesses forest and forest changes using a combination of remote sensing and a ground-based forest carbon inventory approach to estimate emissions, providing estimates that are transparent, consistent and, as far as possible, accurate, and that reduce uncertainties.

Mexico has one of the best programmes in the world for gathering high-quality information about the country's forests for the national forest inventory, which is run through Mexico's National Forestry Commission (Comisión Nacional Forestal; CONAFOR). CONAFOR is a decentralized public body that is responsible for developing and promoting productive activities, conservation, restoration, sustainable use, commercialization and education within the forest sector. It oversees programmes and plans for sustainable forestry development throughout Mexico and supports and coordinates agencies and programmes involved in forest matters.



Detailed guide on best practices for forest data transparency in Bangladesh

- ▶ **Transparency and quality:** The Government of Mexico, through the CONAFOR, has made metadata, microdata and supplementary documents from its INFyS publicly available in FAO's [Microdata Catalog for Food and Agriculture](#). This information from the third sampling cycle (2015–2020) of INFyS includes details on sample design, field data collection methodology, scope, geographic coverage, measured variables and forest indicators. Users can access information on sampling units, forest characteristics, land-use classes, attributes of live and dead trees, regeneration and other variables of interest. Additionally, the confidentiality standards for the country's information are guaranteed and upheld.
- ▶ **Legal and policy basis:** Mexico's NFMS serves as a key instrument of national forestry policy. Recognized as information of national interest, it plays a vital role in informed decision-making for the design, implementation and evaluation of public policies and programmes aimed at promoting the sustainable management of the country's forest ecosystems. The NFMS is one of the seven forest policy instruments outlined in the General Law on Sustainable Forest Development. The implementation and design of this system corresponds to CONAFOR (Art. 34, Section VII and Art. 4° transitory).
- ▶ **Country ownership and responsibility:** The most recent update to the Organic Statute of CONAFOR officially recognizes the Technical Management of the Monitoring, Reporting, and Verification System (Gerencia Técnica del Sistema de Monitoreo Reporte y Verificación; GTSMRV) as an Administrative Unit under the General Coordination of Planning and Information of CONAFOR. This unit is responsible for designing, operating and maintaining the components of the Satellite Forest Monitoring System and the NFMS, thereby contributing to the formalization and sustainability of the NFMS. Notably, a portion of the GTSMRV staff is currently funded through fiscal resources.
- ▶ **Participatory discussion process:** The implementation of the NFMS has involved the collaboration of experts,

- ▶ exchange and constant dialogue with academia, and a series of institutional arrangements for its optimal functioning. The Mexican government has undertaken an ambitious initiative to transform the way in which the INFyS is carried out, adopting an innovative approach that puts local communities at the centre, recognizing their deep knowledge of forests and their crucial role in forest conservation.

Collaboration at the international level:

Mexico's NFMS also receives financial support from various international initiatives, including the Sustainable Forest Landscapes Initiative, the United States Forest Service, and the United Kingdom's Collaboration to Accelerate Climate Transitions.

Research infrastructure and capacity building:

The technical management of the MRV team is made up of specialists in different areas of MRV, and these capacities have been built and retained since 2012 thanks to the support of different initiatives such as the Norwegian Ministry of Foreign Affairs, the Forest Carbon Partnership Facility, the United States Forest Service, Silva-Carbon, the United Kingdom Space Agency, the Inter-American Development Bank, the Tropical Agricultural Research and Higher Education Center and the UN-REDD Programme.

BOX 3: REGIONAL COLLABORATIONS - LATIN AMERICAN AND THE CARIBBEAN

Boosting forest-data transparency through the Latin America and the Caribbean (LAC) National Forest Inventory (IFN-LAC network)

Countries of this region are making significant strides in forest data transparency through the IFN-LAC network. This regional collaboration platform has become a cornerstone for enhancing the quality, consistency and accessibility of forest data across the region. The IFN-LAC network facilitates the exchange of knowledge, best practices and methodologies among member countries, fostering a collaborative approach to forest monitoring and management.

A significant achievement of the IFN-LAC network is the publication of the book *National Forest Inventories of Latin America and the Caribbean: Towards the harmonization of forest information*. This comprehensive resource compiles the experiences and lessons of 21 countries in developing and implementing national forest inventories. The book serves as a valuable guide for all countries in the region and beyond, offering insights into practical challenges and solutions in forest data management.

The network supports countries in developing and refining their national forest inventories by providing technical assistance, training and a platform for sharing experiences. Through this collaboration, LAC countries can align their forest data collection and reporting processes as international standards, such as those set by the United Nations Framework Convention on Climate Change, such as the Paris Agreement pledges.

5. Conclusions

Best practices and actions towards forest data transparency



Integrated monitoring systems:

- ▶ **Best practice:** National systems for monitoring land use, land cover and ecosystems should integrate various subsystems into a unified platform. Such systems ensure comprehensive and consistent data across forests, biodiversity and agricultural resources, supporting multi-objective forest management.

Action: Establish or upgrade national systems that comprehensively monitor land use, land cover and ecosystems. Ensure these systems integrate data across sectors, including

- ▶ forestry, agriculture and biodiversity, to support informed decision-making and sustainable management.

Institutionalization and legal frameworks:

- ▶ **Best practice:** Legal frameworks and institutional arrangements must be clearly established to support the sustainable management of forest data. This involves formalizing roles and responsibilities across relevant institutions to ensure long-term success.

- ▶ **Action:** Governments should institutionalize the roles and responsibilities of different entities involved in forest data management through legal instruments that define interministerial arrangements and ensure coordinated actions across sectors.

Capacity development and training:

- ▶ **Best practice:** Continuous capacity development through targeted training is essential for maintaining high standards in forest data collection, analysis and management. Training should align with international standards to ensure data accuracy and reliability.
- ▶ **Action:** Implement ongoing training programmes to build technical skills in forest data collection, analysis and management. Focus on expertise in the latest methodologies and technologies, ensuring the NFMS remains effective and up to date.

Participatory and interinstitutional collaboration:

- ▶ **Best practice:** A participatory and collaborative approach involving multiple stakeholders is key to the successful development and implementation of forest monitoring systems. This ensures the system meets the diverse needs of all stakeholders.
- ▶ **Action:** Promote collaboration among various stakeholders in the development and maintenance of forest monitoring systems. This inclusive approach ensures that diverse perspectives are incorporated and that the system is widely supported.



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Use of advanced technologies:

- ▶ **Best practice:** The adoption of advanced technologies, such as remote sensing and GIS, is critical for enhancing the precision and reliability of forest data. These technologies support effective monitoring and reporting at both national and international levels.
- ▶ **Action:** Integrate advanced technologies like remote sensing, GIS, and automated data processing into the NFMS. These technologies enhance data collection and analysis accuracy and efficiency, supporting both national and international reporting requirements.

Data accessibility and transparency:

- ▶ **Best practice:** Forest data should be made accessible and transparent through centralized, web-based platforms. This promotes accountability and informed decision-making by providing stakeholders with real-time access to essential data.
- ▶ **Action:** Establish centralized, user-friendly web platforms that provide public access to forest and land-use data. These platforms should enable stakeholders to easily retrieve, analyse and use the data for various purposes, fostering transparency and informed decision-making.

Alignment with international reporting requirements:

- ▶ **Best practice:** Forest monitoring systems should align with international agreements and reporting requirements to ensure that national data contributes to global efforts in combating climate change and promoting sustainability.
- ▶ **Action:** Design NFMSs to align with the reporting requirements of international frameworks like the Paris Agreement, UNFCCC, and the SDGs. This alignment ensures that the data collected contributes to global environmental goals and helps secure international funding.

Significance of transparent forest data for sustainable management

Transparent forest data is fundamental to the sustainable management of forest resources. As the backbone of informed decision-making, accurate and accessible data allows governments, organizations and communities to monitor the health of forests, assess the impact of interventions, and make strategic choices that balance economic development with environmental conservation. In an era when climate change poses unprecedented challenges, the role of forests as carbon sinks and biodiversity reservoirs cannot be overstated. Transparent forest data ensures that all stakeholders, from policymakers to local communities, have the necessary information to implement effective conservation strategies, monitor land-use changes and contribute to global climate action.

The case studies highlighted in this publication demonstrate how countries across different regions have made significant strides in improving forest data transparency. By adopting integrated monitoring systems, formalizing institutional roles, building capacity, fostering collaboration and leveraging advanced technologies, these nations have set the stage for more sustainable and resilient forest management practices. The importance of aligning NFMSs with international requirements further underscores the global dimension of this effort, ensuring that national data contributes to the broader fight against climate change and environmental degradation.

FAO's efforts and potential for further contributions

FAO continues to play a pivotal role in advancing forest data transparency globally. Through initiatives such as the [CBIT-Forest project](#) (funded by the Global Environment Facility), FAO provides technical support, capacity development and financial resources to help countries develop robust NFMSs. These efforts not only have improved the quality and accessibility of forest data but

also have strengthened countries' abilities to meet international reporting obligations and participate in global climate initiatives. FAO's work in facilitating South-South cooperation and fostering regional networks, such as the national forest inventory network in Latin America and the Caribbean and the Asia-Pacific region, will continue to enhance the exchange of knowledge and best practices. This collaborative approach has empowered countries to overcome common challenges, adopt innovative solutions and contribute to a collective effort in preserving the world's forests. Looking ahead, FAO's continued support and engagement will be crucial in scaling up these successes and addressing emerging challenges in forest management.

Globally, FAO is accelerating capacity building, knowledge sharing, and awareness raising in enhancing forest data transparency globally and supporting the implementation of the Paris Agreement Article 13 related to the ETF. FAO will continue to operate through developing capacities for open and transparent data management at national, regional and global levels, implementing innovative global composite learning programmes, sharing knowledge and experiences to build international momentum around forests and transparency, and strengthening and expanding networks with new regional partners, including academia, to ensure sustainable and transparent forest reporting.

Need for continued collaboration to improve forest data transparency globally

The need for continued collaboration and commitment to improving forest data transparency is more urgent than ever. Governments, international organizations, civil society and the private sector must work together to build on the progress made and address the gaps that remain. Transparent forest data is not only a tool for national governance but a critical component of global efforts to combat climate change, protect biodiversity and achieve the SDGs.

FAO calls on all stakeholders to reinforce their efforts in enhancing forest data transparency by investing in capacity building, adopting advanced technologies, and fostering inclusive, multistakeholder collaboration. By doing so, we can ensure that the world's forests are managed sustainably, benefiting current and future generations while contributing to a healthier planet.

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